

A FLORISTIC DESCRIPTION AND STRUCTURAL ANALYSIS OF THE PLANT COMMUNITIES OF THE PUNDA MILIA-PAFURI-WAMBIYA AREA IN THE KRUGER NATIONAL PARK, REPUBLIC OF SOUTH AFRICA:

3. THE *COLOPHOSPERMUM MOPANE* COMMUNITIES

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ABSTRACT

The *Colophospermum mopane* communities of the Punda Milia-Pafuri-Wambya area in the Kruger National Park are described floristically and structurally. Habitat factors such as aspect, slope, soil, geology, altitude and pH of the soil are discussed briefly. The floristic classification of the communities was done by means of the Braun-Blanquet method and the communities are described in terms of the most conspicuous as well as the differential species in the woody and herbaceous strata. The structural analysis was done by means of the Variable Quadrant Plot method and the discussion of the structure of the communities is based on the different growth forms, their canopy spread in different strata and the number of individuals per hectare.

UITREKSEL

'N FLORISTIESE BESKRYWING EN STRUKTURELE ANALISE VAN DIE PLANTGEMEENSAPPE VAN DIE PUNDA MILIA-PAFURI-WAMBIYA GEBIED IN DIE NASIONALE KRUGERWILDTUIN, REPUBLIEK VAN SUID-AFRIKA:

3. DIE *COLOPHOSPERMUM MOPANE* GEMEENSAPPE

Die *Colophospermum mopane* gemeenskappe van die Punda Milia-Pafuri-Wambya-gebied in die Nasionale Krugerwildtuin word aan die hand van hul floristiese samestelling en struktuur, wat onderskeidelik deur middel van die Braun-Blanquetmetode en die Varieerbare Kwadrantperseelmetode gemonster is, bespreek. Daar word kortliks na habitatkenmerke soos aspek, helling, grondkenmerke, geologie, hoogte bo seespieël en die pH van die grond verwys. Die floristiese klassifikasie van die verskillende gemeenskappe word aan die hand van die opvallendste en differensierende spesies van die houtagtige en kruidagtige stratus beskryf. Die strukturele beskrywing is veral op die verskillende groeivorme, hul kroonverspreiding in verskillende stratus en die aantal individue per hektaar gegrond.

INTRODUCTION

In the first paper of this series (Van Rooyen, Theron and Grobbelaar, 1981a) a general description was given of the location, topography, drainage, geology, soil and climate of the Punda Milia-Pafuri-Wambya area as well as a floristic description of the Hygrophilous communities. The second paper (Van Rooyen, Theron and Grobbelaar, 1981b) dealt with floristic and structural aspects of the Sandveld communities in the study area.

*Partly based on an M.Sc. thesis, University of Pretoria.

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METHODS

The non-statistical Braun-Blanquet method has been employed successfully in South Africa since 1969 (Taylor, 1969) and is accepted as a reliable and suitable method of vegetation classification. The Variable Quadrant Plot method (Coetzee & Gertenbach, 1977) which was developed in the Kruger National Park was used during this study to determine the species present, their trunk diameters, growth forms and height classes and to calculate their maximum canopy spread in different strata, total apparent canopy cover and number of individuals per hectare.

In this paper the *Colophospermum mopane* communities are described floristically according to the Braun-Blanquet method (Werger, 1973) and analysed structurally by the Variable Quadrant Plot method (Coetzee & Gertenbach, 1977). The descriptive phrase included in the name of each community is based on the physiognomic vegetation classification of Tinley (1969).

RESULTS AND DISCUSSION

The constancy table (Table 1) shows a number of species that are distributed over the entire area and therefore point out the affinities between the communities. Three main species groups (V, H and P) divide the Table into the Hygrophilous, the Sandveld and the *Colophospermum mopane* communities.

The *Colophospermum mopane* communities, which are characterised by species group P (Table 1), are found mainly on areas underlain by basalt and shale of the Karroo System as well as on the Malvernian Formation (Van Rooyen, 1978).

These communities can be divided into three main groups:

1. The *Colophospermum mopane*-*Euclea divinorum* tree savanna
2. The *Colophospermum mopane*-*Dalbergia melanoxylon*-*Heteropogon contortus* shrub savanna
3. The *Colophospermum mopane*-*Combretum apiculatum*-*Digitaria eriantha* open tree savanna

The *Colophospermum mopane*-*Euclea divinorum* tree savanna (1) is characterised by species group K; the *Colophospermum mopane*-*Dalbergia melanoxylon*-*Heteropogon contortus* shrub savanna (2) by species group L and N, and the *Colophospermum mopane*-*Combretum apiculatum*-*Digitaria eriantha* open tree savanna (3) by species groups O and P. The absence of a group of species, e.g. *Terminalia prunioides*, *Thilachium africanum*, *Acacia tortilis*, *Themedra triandra* and *Enneapogon scoparius* that occur in the other *Colophospermum mopane* communities, also serves to delineate this savanna (3).

The *Colophospermum mopane* communities are mutually related and gradual transitions from one community to another are often encountered. For example, the *Colophospermum mopane*-*Euclea divinorum*-*Enteropogon macrotachyus* tall

TABLE 1.

A constancy table of the plant communities of the Punda Milia—Pafuri—Wambiya area in the Kruger National Park*

PLANT SPECIES	COMMUNITIES																	
	SANDVELD						COLOPHOSPER- MUM MOPANE						DIABASE	HYGRO- PHILOUS				
	1.1	1.2	1.3	1.4	2.1	2.2	1.1	1.2	1.3	2.1	2.2	3	4	1.1	1.2	1.3	1.4	
A <i>Burkea africana</i>	5																	
<i>Fimbristylis hispidula</i>	3			1	1	1						1						
<i>Andropogon gayanus</i>	3					1						1						
<i>Holarrhena pubescens</i>	3																	
<i>Bauhinia galpinii</i>	3				1													
<i>Ochna pulchra</i>	2		1															
B <i>Baphia massaiensis</i>		5																
<i>Grewia microthyrsa</i>		3																
<i>Combretum celastroides</i>		3				1												
<i>Hugonia orientalis</i>		3	1															
<i>Ptaeroxylon obliquum</i>		2																
<i>Pavetta catophylla</i>		2																
<i>Cleistanthus schlechteri</i>		2																
<i>Mariscus</i> sp.		2																
<i>Heinsia crinita</i>	1	2																
<i>Xylia torreana</i>		1																
C <i>Xeroderris stuhlmannii</i>				3														
<i>Aristida junciformis</i>	1			2														
<i>Aristida stipitata</i>	1		3	1														
<i>Indigofera inhambanensis</i>	1		2															
<i>Limeum dinteri</i>			2	1									2					
<i>Macrotyloma axillare</i>			2			1												
<i>Pavonia burchellii</i>			2									1						
<i>Balanites maughamii</i>		1	2		1								2					
D <i>Terminalia sericea</i>	3	2	5	4														
<i>Combretum collinum</i>	3	2	4	3	1								3					
<i>Tricholaena monachne</i>	2	2	3	1	1			1	1	1		1						
<i>Merremia tridentata</i>	4	3	3	3			1	1										
<i>Crotalaria sphaerocarpa</i>	1	1	2	3	1			1				1	1					
<i>Perotis patens</i>	3	3	3	3														
<i>Pteleopsis myrtifolia</i>	3	3	2	1	1													
<i>Eragrostis pallens</i>	2	4	2	2														
<i>Zygoon graveolens</i>	1	2	3	3			1											
<i>Aristida argentea</i>	2	2	1	1														

The constancy value of a plant species in a community is indicated by the following symbols: 1 (1–20 %); 2 (>20–40 %); 3 (>40–60 %); 4 (>60–80 %); 5 (>80–100 %)

*The complete differential table can be found in Van Rooyen (1978).

PLANT SPECIES	COMMUNITIES																
	SANDVELD						COLOPHOSPER- MUM MOPANE					DIABASE	HYGRO- PHILOUS				
	1.1	1.2	1.3	1.4	2.1	2.2	1.1	1.2	1.3	2.1	2.2	3	4	1.1	1.2	1.3	1.4
H <i>Combretum zeyheri</i>	3	2	1	3	3	1											
<i>Borreria scabra</i>	1	2	3	1	1	2											
<i>Pogonarthria squarrosa</i>	4	2	2	3	2	1		1				2					
<i>Strychnos decussata</i>	1	2	1	1	1	1											
<i>Pseudolachnostylis maprounei</i> <i>folia</i>	5	1	1	2	2												
<i>Hexalobus monopetalus</i>	2	3	1	1	2												
<i>Strychnos madagascariensis</i>	3	2	4	3	3			1		3		1					
<i>Ipomoea magnusiana</i>	2	2	4	2		2	1	1				1					
<i>Guibourtia conjugata</i>	2	5	2		2												
<i>Rhynchosia resinosa</i>		2	3	1	2				1								
<i>Triumfetta pentandra</i>	1		1	2	1	2		1									
<i>Diplorhynchus condylocarpon</i>	4			1	3	1											
<i>Alchornea laxiflora</i>	1	4			2	1											
<i>Monodora junodii</i>	2	2		1	3	1											
<i>Celosia trigynia</i>	1	2			2	2		1									
<i>Waltheria indica</i>	2	2		2	3	1		1	1			2					
<i>Hymenocardia ulmoides</i>	2	2			3	1											
<i>Cassia absus</i>	1			2	1	1											
<i>Blepharis maderaspatensis</i>	1			1	2	2											
<i>Tephrosia elongata</i>	2	1	2	1	1			1									
<i>Rhynchosia venulosa</i>	1	1	2		1	1											
<i>Artabotrys brachypetalus</i>	1	1	1	1	2						1						
<i>Agathisanthemum bojeri</i>	2	2		1	1			1									
<i>Tephrosia longipes</i>	2		1	1	1							1					
<i>Crabbea velutina</i>	1		2		1	1		1					2				
<i>Hippocratea longipedunculata</i>		1	1	1	1												
<i>Ximenia caffra</i>	1			1													
<i>Ozoroa paniculosa</i>	1			1	1						1						
<i>Ozoroa engleri</i>			1	1													
I <i>Urochloa mosambicensis</i>				1			5	1		1	1	2		4	2		
<i>Chloris virgata</i>				1			4	1	1					2			
<i>Acacia tortilis</i>							3	1							2	1	
<i>Salvadora angustifolia</i>							2		1								
<i>Boerhavia diffusa</i>							2									1	
<i>Azima tetracantha</i>							2										
<i>Alternanthera pungens</i>							1										
<i>Trianthema triquetra</i>							1										
<i>Setaria verticillata</i>							1										
<i>Acacia senegal</i>					1		1										
<i>Cyathula crispula</i>							1										
J <i>Ximenia americana</i>			1	1			1	4									
<i>Enteropogon macrostachyus</i> ..					1	2	1	3	1								

PLANT SPECIES	COMMUNITIES																
	SANDVELD						COLOPHOSPER- MUM MOPANE					DIABASE	HYGRO- PHILOUS				
	1.1	1.2	1.3	1.4	2.1	2.2	1.1	1.2	1.3	2.1	2.2	3	4	1.1	1.2	1.3	1.4
<i>Tetrapogon tenellus</i>							1	2									
<i>Chloris roxburghiana</i>							1	2									
<i>Acacia grandicornuta</i>							2	1									
<i>Amaranthus thunbergii</i>							1	1									
K <i>Commiphora glandulosa</i>					1		2	1	3		1						
<i>Abutilon fruticosum</i>					1	1	2	2	2								
<i>Ecobolium revolutum</i>							2	2	2								
<i>Sporobolus smutsii</i>	1			1	1		2	1	1								
<i>Thilachium africanum</i>				1			2	1	1				2				
<i>Corbichonia decumbens</i>							1	1	2								
<i>Sporobolus fimbriatus</i>								1	1								
<i>Aristida rhiniochloa</i>								1	1								
L <i>Enneapogon scoparius</i>										5							
<i>Euclea schimperi</i>				1						4							
M <i>Terminalia prunioides</i>							1	3	2	3							
<i>Maerua parvifolia</i>				2	1		3	3	2	1			2				
<i>Seddera capensis</i>							1	2	3	5	1	1					
<i>Elytraria acaulis</i>								2	2			1					
<i>Zanthoxylum capense</i>							1	1	2	2							
N <i>Themeda triandra</i>								1			5		2				
<i>Neorautanenia amboensis</i>								1	1		4						
<i>Setaria woodii</i>							1	1	1		3						
<i>Urochloa brachyura</i>								1			2						
<i>Panicum coloratum</i>											2			3			
O <i>Heteropogon contortus</i>	1				1			1	2	4	4	2	2		2		
<i>Bothriochloa insculpta</i>							1	2	3		4		2		2		
<i>Phyllanthus maderaspatensis</i>								1	2	2	1	1					
<i>Fingerhuthia africana</i>								1	2	3	1	2					
<i>Indigofera heterotricha</i>								1	2	1	2	1					
<i>Sorghum versicolor</i>								1	2		3	1					
<i>Heliotropium strigosum</i>				2					2		2	1					
<i>Oropetium capense</i>								1	1	1	1	1					
P <i>Colophospermum mopane</i>				2	1		3	5	5	5	5	5		5	4		
<i>Euclea divinorum</i>	1			1			1	3	1	2		1		5	3		
<i>Aristida congesta</i> subsp. <i>barbi-</i> <i>collis</i>				1			1	2	3	2	3	2					
<i>Neuracanthus africanus</i>					1		1	2	4	1	1	2					
<i>Barleria lancifolia</i>					1		1	2	2	2		1					
<i>Eragrostis rigidior</i>		1		1	1		1	1		2	2	1					

PLANT SPECIES	COMMUNITIES																
	SANDVELD						COLOPHOSPER- MUM MOPANE						DIABASE	HYGRO- PHILOUS			
	1.1	1.2	1.3	1.4	2.1	2.2	1.1	1.2	1.3	2.1	2.2	3		4	1.1	1.2	1.3
<i>Eragrostis superba</i>							1	1	1	2	4	1					1
<i>Combretum hereroense</i>					1		1	1	1	1	1		3		2		1
<i>Dicoma tomentosa</i>							1	1	1	1	1	1					
<i>Dalechampia galpinii</i>								1	2								
<i>Aptosimum lineare</i>								1	2								
<i>Sterculia rogersii</i>					1				1	2		1					
Q <i>Combretum apiculatum</i>	2	2	5	4	5	1	1	1	5	4	2	5					
<i>Aristida congesta</i> subsp. <i>con-</i> <i>gesta</i>	1	2	3	3	2	2	3	4	5	5	3	3					
<i>Indigofera vicioides</i>	1	3	1	1	1	1	1	2	3	4	2	2	2				
<i>Cissus lonicerifolius</i>	1	2	2	2	1	1	1	1	3	1	2	2					
<i>Hermannia glanduligera</i>	3	2	1	3	2	1	1	1	1	1	2	1	3				
<i>Rhynchosia totta</i>	3	1	2		1	1	1	1	3	3	2	2	3				
<i>Phyllanthus burchellii</i>	1	5	3	1	1	3		1	3		1	2	2				
<i>Hibiscus engleri</i>	2	2	2	2	2	2	1			1	1	1		2			
<i>Brachiaria nigropedata</i>	2	3	1	3	1	1		1	1		2	2					
<i>Vigna unguiculata</i>	3	2	4	4	1	1	1	1			2	2					
<i>Commelina africana</i>	2		2	1	1	1	2	1			1	1					
<i>Acalypha indica</i>	1		1	2	1	1	2	1	2	2	1	1	2				
<i>Boscia albitrunca</i>	1	1	2	3	2	1	1	1	1			2					
<i>Commelina erecta</i>	2	3	1	2	2	1	2	1	1			2					
<i>Monechma monechmoides</i>		1	3	2	1	2	1	1	3		1	1					
<i>Enneapogon cenchroides</i>	1		1	3	2	1	3	4	5	2	2	2					
<i>Phyllanthus pentandrus</i>	1		1	1	1	1	1	2	1	4	1	3					
<i>Tephrosia polystachya</i>	1	2	5	3	1	1		1	3	3		2	3				
<i>Cassia abbreviata</i>	1	1	1		1	1			1		1	1					
<i>Schmidtia pappophoroides</i>	2	2	4	4	1			2	2		3	4					
<i>Hibiscus sidiformis</i>		1	1	1	1	2	1	1	2			2					
<i>Kyphocarpa angustifolia</i>	1	1	1	1	3				1	2	1	2					
<i>Grewia bicolor</i>	1		2	2	2	1	3	4	4	4	2	3	2				
<i>Dalbergia melanoxylon</i>	2		4	3	1		1	1	1	4	3	2					
<i>Pseudobrachiaria deflexa</i>		2			1	3	2	1	3		1	1					
<i>Pupalia lappacea</i>	1			2	2	3	3	1	2				2				
<i>Evolvulus alsinoides</i>	1	1	1	2	2	1		1	3	2		1					
<i>Tragus berteronianus</i>			1	1	1		3	1	1	1	1	1					
<i>Cassia mimosoides</i>	1			2		1		1			2	1					
<i>Euphorbia polycnemoides</i>	1			1	3	1		1	3	2	1	2					
<i>Crotalaria virgulata</i>		1	1	1		1		2	1								
<i>Euphorbia tettensis</i>	2		3	2				1	3	1	1	2					
<i>Maytenus heterophylla</i>			1		1		1	1	1	4	1						
<i>Cucumis anguria</i>				2		1	1	1	1		1			2			
<i>Corchorus asplenifolius</i>	1			3		1	1		2	2	1	1		2		3	
<i>Lantana rugosa</i>	2		1		1	1			1		2						
<i>Tricalysia allenii</i>	1	1		1	2				1		1						

PLANT SPECIES	COMMUNITIES																
	SANDVELD						COLOPHOSPERMUM MOPANE					DIABASE	HYGROPHILOUS				
	1.1	1.2	1.3	1.4	2.1	2.2	1.1	1.2	1.3	2.1	2.2	3	4	1.1	1.2	1.3	1.4
<i>Ipomoea obscura</i>				1		1	2	1	1		1	1					
<i>Grewia monticola</i>			3	1	1	1		1				1					
<i>Mundulea sericea</i>	1		1	1	1				1			1					
<i>Cymbopogon excavatus</i>				1					1	1	2	1	3	2			
<i>Markhamia acuminata</i>				2	1				1		1	1					
<i>Gardenia resiniflua</i>			1	1	1	1	1	1	1								
<i>Justicia protracta</i>	1							1	1								
<i>Barleria affinis</i>					1				1								
<i>Stylochiton natalensis</i>	1				1	1		1									
<i>Eragrostis curvula</i>			1									1					
<i>Ipomoea pes-tigrides</i>	1	2		1			1	1									
<i>Zornia diphylla</i>	1	2		1	1				1			1					
<i>Clerodendron ternatum</i>	1		1	1				1	1	1	1	1					
<i>Justicia flava</i>					1		1	1				1					
<i>Manilkara mochisia</i>	1			1	1			1									
<i>Rhynchosia minima</i>	1							1				1	1				
<i>Eragrostis heteromera</i>				1			1		1								
<i>Grewia hexamita</i>		1	1	1	1	1			1		1		2				
<i>Gisekia africana</i>				1			2				1						
<i>Commiphora edulis</i>					1	1			1								
<i>Anisotes sessiliflorus</i>		1			1		1	1	1								
<i>Cardiospermum halicacabum</i>					1			1									
<i>Aspilia mossambicensis</i>	1								1			1					
<i>Dactyloctenium aegyptium</i>				1			1										
<i>Polygala wilmsii</i>	2		1		1				1		1						
<i>Calostephane divaricatum</i>				1	1			1	1								
<i>Hermbstaedtia odorata</i>	1							1		1		1					
<i>Kyllinga alba</i>	1					1		1				1	1				
<i>Kohautia virgata</i>	2						1	1		1		1					
<i>Gardenia spatulifolia</i>			1	1		1											
<i>Cissus quadrangularis</i>					1	1	1	1									
<i>Stipagrostis uniplumis</i>	1			1				1		1							
<i>Eragrostis lehmanniana</i>				1				1	1								
<i>Leptactinia benguelensis</i>		1	1		1	1		1									
<i>Ipomoea crassipes</i>											1						
<i>Orthosiphon suffrutescens</i>								1	1								
<i>Grewia villosa</i>					1	1	1		1		1						
<i>Lippia javanica</i>								1	1				2				
<i>Merremia palmata</i>											1	1					
<i>Endostemon tenuiflorus</i>									1	1							
R <i>Setaria holstii</i>													4	3	2		
<i>Piliostigma thonningii</i>													3				
<i>Hyparrhenia rufa</i>													3				
<i>Helichrysum miconiifolium</i>													3				

PLANT SPECIES	COMMUNITIES																
	SANDVELD						COLOPHOSPER- MUM MOPANE						DIABASE	HYGRO- PHILOUS			
	1.1	1.2	1.3	1.4	2.1	2.2	1.1	1.2	1.3	2.1	2.2	3	4	1.1	1.2	1.3	1.4
<i>Ipomoea papilio</i>						1							3				
<i>Acacia gerrardii</i>											1		2				
S <i>Acacia borleae</i>														5			
<i>Tetrapogon mossambicensis</i> ..								1						5			
<i>Cephalocroton mollis</i>											1			5			
<i>Ruellia patula</i>				1			1	1	1			1	1	5			
<i>Brachiaria erucaeformis</i>														3			
T <i>Sesbania sesban</i>															4		
<i>Fuirena pubescens</i>															3		
U <i>Acacia albida</i>																5	
<i>Ficus sycomorus</i>																4	
<i>Acacia robusta</i>																4	
<i>Trichilia emetica</i>																4	
<i>Diospyros mespiliformis</i>																4	
<i>Hypoestes verticillaris</i>																3	
<i>Abutilon angulatum</i>																3	
<i>Tabernaemontana elegans</i>	1				1											3	
V <i>Setaria sphacelata</i>									1			1	2	3	3		3
<i>Ischaemum afrum</i>														5	4		2
<i>Ischaemum brachyatherum</i> ...														3	2		1
<i>Panicum meyerianum</i>															4	3	4
<i>Echinochloa pyramidalis</i>															3	2	2
<i>Acacia xanthophloea</i>																3	1
<i>Sporobolus consimilis</i>																2	2
<i>Xanthocercis zambesiaca</i>																3	1
<i>Kigelia africana</i>																2	1
<i>Cyperus fenzelianus</i>																	2
<i>Croton megalobotrys</i>																	1
<i>Chloris gayana</i>	1																1
W <i>Panicum maximum</i>	4	5	5	5	4	3	5	4	4	1	3	4	2		4	5	3
<i>Digitaria eriantha</i>	5	4	5	5	5	2	1	3	4	4	5	5	2	3	3	4	
<i>Hibiscus micranthus</i>	1	1	2	2	3	3	3	4	5	3	1	4			2		
<i>Lonchocarpus capassa</i>	1	1		3	1	1	1	1					3		4	4	2
<i>Spirostachys africana</i>	1	3	1	1	1		1	2							4		1
<i>Combretum imberbe</i>				1			1	1	1	1	3	1	2		3	3	2
<i>Solanum panduraeforme</i>	2			2	2	2	1	2	2	1	2	3			2		1
<i>Dichrostachys cinerea</i>	2	3	1	3	2	1	1	1	2	2	2	3	4		2		1
<i>Combretum mossambicensis</i> ..	1	2	2	3	1	1	1	1	2	1		2	2				1
<i>Acacia nigrescens</i>	1			2	2		2	3	3	4	2	4	3		4		
<i>Securinea virosa</i>		2	1	1	1		1	1	1		1	1		5			1

PLANT SPECIES	COMMUNITIES																	
	SANDVELD						COLOPHOSPER- MUM MOPANE					DIABASE	HYGRO- PHILOUS					
	1.1	1.2	1.3	1.4	2.1	2.2	1.1	1.2	1.3	2.1	2.2	3	4	1.1	1.2	1.3	1.4	
<i>Vernonia fastigiata</i>	4			1	2	2	1	1	2	1	3	1		5				
<i>Cenchrus ciliaris</i>			1				1	1	2		2	1					1	
<i>Achyranthes aspera</i>	1			1	1	3	1	1	1							5	1	
<i>Indigofera rhytidocarpa</i>	1	1		2			3	1	1	2	1	1						
<i>Lannea stuhlmannii</i>		2	1	1			1	1	1		1	1			2			
<i>Leucas glabrata</i>	1		1	2	1	1	1	1	2								1	
<i>Melhania forbesii</i>	1	1	3	2	1		2	1		1	1	2						
<i>Monechma divaricatum</i>			1	2			1	1									1	
<i>Sclerocarya caffra</i>	1	1	2	1	1					1	1	1						
<i>Rhynchelytrum villosum</i>			1	2	1	2		1	2	3	1	1	2		2			
<i>Commiphora mollis</i>				2				1	2	2		1						
<i>Becium obovatum</i>				1		1	1	1	3			1						
<i>Asparagus setaceus</i>	1			1	1	2	2	1	1	1	1	1		3				
<i>Corchorus kirkii</i>		2	2	1	1		1	1	1		1	1			3		1	
<i>Tragia rupestris</i>	1		1	1	1		1	1			1	2			2		1	
<i>Grewia flavescens</i>		2		1	1	1		1								2		
<i>Maytenus senegalensis</i>				1									2				1	
<i>Leonotis nepetifolia</i>	2			1	1	1							2				1	
<i>Pterocarpus rotundifolius</i>											1		2					
<i>Ceratotheca triloba</i>				1			1		1		1				2			
<i>Barleria transvaalensis</i>							1	1	1									
<i>Peltophorum africanum</i>	2				1				1				2					
<i>Hemizygia bracteosa</i>	1	1	2	1	1					1		1			2			
<i>Albizia harveyi</i>										1		1			2			
<i>Abutilon guineense</i>				1	1		1	1	1					2			1	
<i>Ziziphus mucronata</i>				1	1		1	1		1		1					1	
<i>Melhania rehmannii</i>					1	1		1			1						1	
<i>Cyperus</i> sp.					1		1	1		1					2			
<i>Ormocarpum trichocarpum</i> ...								1			1		2		2			
<i>Abutilon ramosum</i>							1				1		2				1	
<i>Indigofera schimperi</i>	1				1						1	1		3	2			
<i>Cassia petersiana</i>	1	1	1	1							1		2					

tree savanna and the *Colophospermum mopane*-*Themeda triandra* shrub savanna change gradually into the *Colophospermum mopane*-*Commiphora glandulosa*-*Seddera capensis* open tree savanna to the north. In general all the *Colophospermum mopane* communities are characterised by the following habitat factors: shallow to moderately deep sandy clay loam to clay soils; neutral pH; presence of carbonates; soils that have a normal soluble salt concentration to soils that are fairly leached. The communities occur on alluvium, shale, basalt, andesite and the Malvern Formation on plains or undulating country.

1. The *Colophospermum mopane*–*Euclea divinorum* tree savanna

This savanna is found on alluvial soils and basalt hills in the Pafuri area as well as on shale in the Punda Milia area. It is subdivided into three communities (1.1, 1.2, 1.3) (Table 1). The *Colophospermum mopane*–*Acacia tortilis*–*Urochloa mosambicensis* tree savanna (1.1) is characterised by species group I; the *Colophospermum mopane*–*Euclea divinorum*–*Enteropogon macrostachyus* tall tree savanna (1.2) by species group J and the *Colophospermum mopane*–*Commiphora glandulosa*–*Seddera capensis* open tree savanna (1.3) by species group K, while the relationships between these three communities and the other *Colophospermum mopane* communities is indicated by the mutual presence of species group P.

According to Werger and Coetzee (1977) *Euclea divinorum* together with *Enteropogon macrostachyus*, *Achyranthes* spp., *Chloris virgata* and *Dactyloctenium aegyptium* can be regarded as differential species of the brackish plains in the Transvaal Lowveld. *Adansonia digitata* is strongly associated with the *Colophospermum mopane*–*Commiphora glandulosa*–*Seddera capensis* open tree savanna (1.3) and forms a prominent feature along the Nyala Drive and in the Mukahandja area (Fig. 5).

The major difference between the habitat of these three communities lies in the geological substrate on which they are found. Community 1.1, 1.2 and 1.3 are found on alluvial plains, shale and basalt respectively. Community 1.3 is also characterised by a shallow, rocky soil with high carbonate concentrations.

1.1 The *Colophospermum mopane*–*Acacia tortilis*–*Urochloa mosambicensis* tree savanna

This community is found along the Levubu River in the Pafuri area and in the vicinity of Punda Milia where it occurs along the Madzaringwe stream as well as the Levubu River. It usually occurs on alluvial flood plains between 200 and 460 m above sea level (Figs 1 & 2).

The fine to medium textured sandy clay loam to clay soils vary from brown to brownish black. Up to five per cent of the soil surface is covered by stones and usually the soil is deeper than 1 m. The topsoil has a moderately developed blocky structure with a friable to firm consistency and a pH ranging from 6.0 to 8.8. Carbonates are often present.

Floristic composition

Trees grow up to 8 m high with *Acacia tortilis* being the most conspicuous species especially in the Pafuri area. Shrubs and sparse shrubs, usually reaching 2 m in height, include species such as *Maerua parvifolia*, *Grewia bicolor* and *Azima tetraantha*. Species favouring the brackish plains along the Levubu River are *Acacia senegal* var. *rostrata*. Associated species within this community are

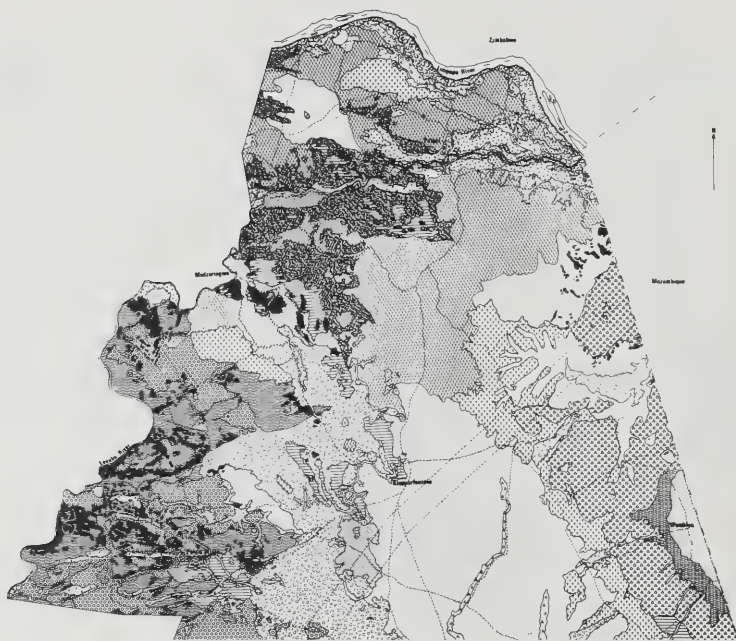


FIG. 1.

Vegetation map of the Punda Milia-Pafuri-Wambya area in the Kruger National Park.

Commiphora glandulosa, *Ximenia americana*, *Thilachium africanum*, *Gardenia resiniflua*, *Maytenus heterophylla* and *Dalbergia melanoxylon*.

In certain areas the herbaceous component is poorly developed. Sporadic flooding as well as intense grazing and browsing in these areas lead to an abundance of pioneer species such as *Alternanthera pungens*, *Trianthema triquetra*, *Cyathula crispula*, *Corbichonia decumbens*, *Pupalia lappacea*, *Tragus berteronianus* and *Aristida congesta* subsp. *congesta*. However, in a favourable rainy season a good grass cover of *Urochloa mosambicensis* and *Panicum maximum* is formed, together with species such as *Chloris virgata*, *Sporobolus smutsii*, *Enneapogon cenchroides* and *Hibiscus micranthus*. A number of widespread herbaceous species within this community are *Chloris roxburghiana*, *Setaria verticillata*, *Urochloa trichopus*, *Mollugo nudicaulis*, *Epaltes gariepina*, *Acanthospermum hispidum*, *Dactyloctenium aegyptium*, *Justicia protracta* and *Pseudo-brachiaria deflexa*.



FIG. 2.

The *Colophospermum mopane*-*Acacia tortilis*-*Urochloa mosambicensis* tree savanna on alluvial soil along the Levubu River.

Termitaria occur throughout this community and an entire termitarium is often covered by *Capparis tomentosa* which grows in the form of a dense bush. According to Wild (1952) members of the family Capparaceae are frequently found on termitaria in southern Zimbabwe.

In Figure 1 this tree savanna is subdivided into 3 communities namely the *Acacia tortilis* tree savanna, the *Acacia senegal* shrub savanna and the *Salvadora angustifolia* shrub savanna.

Structure

The structural analysis of the woody component of this community is given in Tables 2 and 3 as well as in Figures 10 and 11.

A high total percentage canopy spread is found in the 1 m and 2 m strata while the higher strata, e.g. the > 6 m stratum is relatively poorly developed (Table 2). *Colophospermum mopane* and *Acacia tortilis* (Table 3) are species that contribute significantly to the canopy spread in the 1 m and 2 m strata. In the 0.5 m stratum *Colophospermum mopane*, *Acacia tortilis* and *Maerua parvifolia* have high canopy spread percentages. Species of the 3 m height class have

TABLE 2.

Percentage canopy spread in different strata and the mean number of individuals per hectare (indiv./ha) in different height classes of woody plant species in the *Colophospermum mopane*-*Acacia tortilis*-*Urochloa mosambicensis* tree savanna.

Stratum (m)	Percentage canopy spread										Mean number of indiv./ha				
	Total*	Growth form			Height class						Height class (m)	Total	Growth form		
		Tree	Sparse shrub	Shrub	> 6m	4–5m	3 m	2 m	1 m	0,5 m			Tree	Sparse shrub	Shrub
> 6	2,23	1,91	0,22	0,10	2,23						> 6	17	16	1	
4–5	5,24	2,77	1,69	0,78	2,29	2,95					4–5	53	18	27	8
3	8,61	2,86	3,80	1,95	1,54	3,62	3,45				3	206	28	122	56
2	12,33	2,64	6,30	3,39	1,12	2,93	5,06	3,22			2	250	53	126	71
1	11,71	1,93	6,37	3,41	0,74	1,64	3,77	3,32	2,24		1	354	32	203	119
0,5	8,07	0,69	4,24	3,14	0,22	0,71	1,93	1,92	2,14	1,15	0,5	323	61	183	79
											Total	1 203	208	662	333

*Figures in this column are referred to in the text as "Total percentage canopy spread" values

TABLE 3.
Percentage canopy spread in different strata; mean number of individuals per hectare (indiv./ha) and the percentage apparent canopy cover (p.a.c.) of a few species* in the *Colophospermum mopane*-*Acacia tortilis*-*Lrochloa mosambicensis* tree savanna.

Plant species*	p.a.c.	Indiv./ha	Stratum (m)					Percentage canopy spread				
			> 6	4-5	3	2	1	0,5				
<i>Colophospermum mopane</i>	8,29	369	1,21	1,91	3,34	5,23	5,01	3,30				
<i>Acacia tortilis</i>	5,64	158	0,88	2,42	3,44	3,77	2,43	0,91				
<i>Maerua parvifolia</i>	1,03	87				0,08	0,77	0,92				
<i>Balanites pedicularis</i>	0,92	50		0,21	0,21	0,87	0,59	0,06				
<i>Salvadora angustifolia</i>	0,81	73		0,21	0,21	0,67	0,54	0,48				
<i>Anisotes sessiliflorus</i>	0,70	70					0,21	0,68				
<i>Acacia senegal</i> var. <i>rostrata</i>	0,64	32		0,29	0,47	0,44	0,21	0,14				
<i>Acacia grandicornuta</i>	0,63	8				0,56	0,42	0,21				
<i>Grewia bicolor</i>	0,60	35		0,43		0,09	0,58	0,38				
<i>Azima tetracantha</i>	0,56	161						0,47				

*Only the ten species with the highest percentage apparent canopy cover (p.a.c.)

the highest total percentage canopy spread in the 2 m stratum (5,06 %). The 0,5 m and 1 m height classes, where shrubs and sparse shrubs are most numerous, have the highest densities (Table 2).

Species with the highest percentage apparent canopy cover (p.a.c.) and densities are *Colophospermum mopane* (8,29 % and 369 indiv/ha), *Acacia tortilis* (5,64 % and 158 indiv/ha) and *Maerua parvifolia* (1,03 % and 87 indiv/ha) (Table 3). *Azima tetracantha* has a low percentage apparent canopy cover but a high density.

1.2 The *Colophospermum mopane*-*Euclea divinorum*-*Enteropogon macrostachyus* tall tree savanna

This community is usually found on shale at 215 to 460 m above sea level on plains as well as on gentle slopes with a gradient up to 8° (Figs 1 & 3).

The dark brown to brownish black, fine to medium textured loamy sand to clay soils range from 70 mm to more than 1 m deep. Up to 20 % of the soil surface is covered by stones. The topsoil has a moderate blocky structure, a friable consistency and a pH between 6.1 and 8.7. The soils have a moderate salt concentration or are sometimes strongly leached. Carbonates are present in most cases.



FIG. 3.

The *Colophospermum mopane*-*Euclea divinorum*-*Enteropogon macrostachyus* tall tree savanna on shale of the Karroo System.

Floristic composition

Trees, mainly *Colophospermum mopane*, *Acacia nigrescens* and *Spirostachys africana*, grow up to 15 m tall. The tallest individuals are found in areas with a deep sandy clay loam. This coincides with the findings of Thompson (1960) that *Colophospermum mopane* will grow better on fertile, slightly acid, friable, permeable soils. The shrub and sparse shrub strata are well developed up to 3 m and are characterised by species such as *Euclea divinorum*, *Grewia bicolor* and *Ximenia americana*. The associated species in this community are *Maerua parvifolia*, *Zanthoxylum capense*, *Thilachium africanum*, *Acacia grandicornuta*, *Combretum imberbe*, *Dichrostachys cinerea* and *Combretum hereroense*.

The herbaceous component consists mainly of *Enteropogon macrostachyus*, *Enneapogon cenchroides*, *Chloris roxburghiana*, *Amaranthus thunbergii*, *Panicum maximum* and *Hibiscus micranthus*. While *Enneapogon cenchroides* is found mainly on relatively shallow rocky soils. *Enteropogon macrostachyus* favours deeper soils. Other common herbaceous species within this tall tree savanna are *Aristida congesta* subsp. *congesta*, *Digitaria eriantha*, *Tetrapogon tenellus*, *Seddera capensis*, *Elytrarea acaulis*, *Abutilon fruticosum*, *Ecbolium revolutum*, *Bothriochloa insculpta*, *Crotalaria virgulata* and *Indigofera vicioides*.

Terminalia prunioides and *Commiphora* spp. only occur north of Xantangelane in this community.

Structure

The structural analysis of the woody component of the tall tree savanna is given in Tables 4 and 5 as well as in Figures 10 and 11.

In general a relatively high total percentage canopy spread is found from the 0.5 m to the 4–5 m stratum, with the highest percentage in the 2 m stratum (Table 4). Species contributing substantially to the canopy spread in this stratum are *Colophospermum mopane*, *Euclea divinorum*, *Gardenia resiniflua* and *Terminalia prunioides* (Table 5). In the >6 m stratum *Colophospermum mopane* and *Spirostachys africana* are the important species. Shrubs have the highest total percentage canopy spread in the 0.5 m and 1 m strata, sparse shrubs in the 2 m and 3 m strata and trees in the 4–5 m and >6 m strata. The largest mean number of individuals occur in the 0.5 m and 1 m height classes where shrubs and sparse shrubs are the most numerous of the various growth forms while the sparse shrubs collectively have the highest density. The relatively high density in the >6 m height class is apparent from Table 4. Many of these trees reach 15 m in height. *Colophospermum mopane* and *Euclea divinorum* are physiognomically the most conspicuous species and have the highest densities and percentage apparent canopy cover.

1.3 The *Colophospermum mopane*–*Commiphora glandulosa*–*Seddera capensis* open tree savanna

This open tree savanna lies in the northern part of the study area, between

Percentage canopy spread in different strata and the mean number of individuals per hectare (indiv./ha) in different height classes of woody plant species in the Colophospermum mopane-Euclea divinorum-Enteropogon macrostachyus tall tree savanna.

*Figures in this column are referred to in the text as "Total percentage canopy spread" values

TABLE 5.

Percentage canopy spread in different strata; mean number of individuals per hectare (indiv./ha) and the percentage apparent canopy cover (p.a.c.) of a few species* in the *Colophospermum mopane*-*Euclea divinorum*-*Enteropogon macrostachyus* tall tree savanna.

Plant species*	p.a.c.	indiv./ha	Percentage canopy spread					
			Stratum (m)					
			> 6	4-5	3	2	1	0,5
Colophospermum mopane	19,02	1 322	4,83	6,36	7,35	9,11	8,63	5,37
Euclea divinorum	2,50	162			0,25	1,97	1,76	1,03
Spirostachys africana	2,42	49	0,71	2,03	1,58	0,52	0,10	0,02
Grewia bicolor	1,39	108			0,01	0,66	1,12	0,87
Terminalia prunioides	1,35	34	0,14	0,60	1,00	0,75	0,46	0,34
Combretum apiculatum	1,25	59	0,02	0,54	0,90	0,71	0,43	0,17
Gardenia resiniflua	0,94	19			0,42	0,89	0,75	0,47
Acacia grandicornuta	0,86	42			0,52	0,65	0,40	0,09
Anisotes sessiliflorus	0,73	100					0,47	0,73
Securinega virosa	0,63	45				0,27	0,53	0,39

*Only the ten species with the highest percentage apparent canopy cover (p.a.c.)

215 and 415 m above sea level. It occurs mainly on basalt, on plains as well as on moderate to steep slopes with a gradient up to 12° (Figs 1, 4 & 5).

The basalt, andesite and shale, underlying this savanna, weathers to a fine textured brownish black sandy clay loam to clay soil. The soils are from 30 mm to 600 mm deep and up to 40 % of the surface is covered with stones and rocks. The topsoil is apedal with a moderately to well developed blocky structure and a loose to friable consistency. The soil is neutral to alkaline and has a normal to moderate soluble salt concentration. Carbonates are usually present in high concentrations.



FIG. 4.

The *Colophospermum mopane*-*Commiphora glandulosa*-*Seddera capensis* open tree savanna on basalt in the Pafuri area.

Floristic composition

The physiognomically striking species, *Colophospermum mopane*, *Kirkia acuminata*, *Sclerocarya caffra* and *Adansonia digitata*, are 6 to 10 m high. The smaller trees and sparse shrubs such as *Combretum apiculatum* and *Commiphora glandulosa*, reach a height of 6 m, while shrubs such as *Grewia bicolor*, *Terminalia prunioides* and *Cissus lonicerifolius* are up to 2 m tall. Other widespread species include *Acacia nigrescens*, *Maerua parvifolia*, *Zanthoxylum capense*,



FIG. 5.

Adansonia digitata, one of the most conspicuous trees in the *Colophospermum mopane*–*Commiphora glandulosa*–*Seddera capensis* open tree savanna.

Commiphora mollis, *C. edulis*, *Sterculia rogersii*, *Markhamia acuminata*, *Gardenia resiniflua*, *Grewia villosa*, *Dichrostachys cinerea* and *Combretum mossambicense*. Whereas *Euclea divinorum*, *Spirostachys africana* and *Lonchocarpus capassa* are abundant in the previously described tall tree savanna they are almost absent in this open tree savanna.

The herbaceous component is characterised by the presence of *Enneapogon cenchroides*, *Aristida congesta* subsp. *congesta*, *Hibiscus micranthus*, *Neuracanthus africanus*, *Panicum maximum* and *Digitaria eriantha*. Other associated herbaceous species are *Aristida congesta* subsp. *barbicollis*, *Evolvulus alsinoides*, *Rhynchosia totta*, *Euphorbia tettensis*, *Seddera capensis*, *Fingerhuthia africana*, *Bothriochloa insculpta*, *Ecbolium revolutum*, *Indigofera vicioides*, *Monechma monechmoides*, *Tephrosia polystachya* and *Dalechampia galpinii*.

Structure

The structural analysis of this open tree savanna is given in Tables 6 and 7 as well as in Figures 10 and 11.

The highest total percentage canopy spread is found in the 2 m stratum (Table 6) where *Combretum apiculatum*, *Colophospermum mopane* and *Grewia*

TABLE 6.

Percentage canopy spread in different strata and the mean number of individuals per hectare (indiv./ha) in different height classes of woody plant species in the *Colophospermum mopane*–*Commiphora glandulosa*–*Seddera capensis* open tree savanna.

Stratum (m)	Percentage canopy spread										Mean number of indiv./ha				
	Total*	Growth form			Height class						Height class (m)	Total	Growth form		
		Tree	Sparse shrub	Shrub	> 6m	4–5m	3 m	2 m	1 m	0,5 m			Tree	Sparse shrub	Shrub
> 6	5,87	5,31	0,56		5,87						> 6	55	51	4	
4–5	9,60	7,04	1,99	0,57	5,10	4,50					4–5	132	74	43	15
3	12,32	5,25	3,57	3,50	2,47	4,50	5,35				3	241	84	102	55
2	16,01	3,52	6,25	6,22	1,36	3,00	6,73	4,90			2	392	77	183	132
1	13,02	1,90	5,51	5,61	0,32	1,33	3,62	4,62	3,13		1	448	54	256	138
0,5	8,99	0,78	3,49	4,72	0,09	0,44	1,28	2,93	2,75	1,50	0,5	457	62	297	98
											Total	1 725	402	885	438

*Figures in this column are referred to in the text as "Total percentage canopy spread" values

TABLE 7.

Percentage canopy spread in different strata: mean number of individuals per hectare (indiv./ha) and the percentage apparent canopy cover (p.a.c.) of a few species* in the *Colophospermum mopane*-*Commiphora glandulosa*-*Seddera capensis* open tree savanna.

Percentage canopy spread		Stratum (m)						Plant species*	p.a.c.	indiv./ha
		1	2	3	4-5	>6				
4.38	5.83	5.92	5.46	6.42	4.41	994	16.20	<i>Colophospermum mopane</i>		
1.38	3.58	6.67	4.82	1.22	0.07	241	8.42	<i>Combretum apiculatum</i>		
0.07	0.08	0.16	0.19	0.40	0.18	24	0.50	<i>Grewia bicolor</i>		
0.19	0.18	0.02	0.04	0.15	0.03	18	0.29	<i>Cissus lonicifolia</i>		
0.15	0.09	0.23	0.03	0.15	0.03	7	0.23	<i>Mundula sericea</i>		
0.13	0.19	0.02	0.02	0.15	0.03	17	0.20	<i>Zanthoxylum capense</i>		

*Only the ten species with the highest percentage apparent canopy cover (p.a.c.)

bicolor contribute more than the other species to the high value. Shrubs and sparse shrubs have high total percentage canopy spread values in the lower strata (up to 2 m) whereas trees have the highest percentage in the 3 m and higher strata (Table 7). In the >6 m stratum *Colophospermum mopane*, *Acacia nigrescens* and *Commiphora glandulosa* have high canopy spread percentages.

Individuals of the 0.5 m, 1 m and 2 m height classes, where sparse shrubs are most numerous, occur in high densities. Although sparse shrubs have the highest densities up to the 3 m stratum, they do not contribute the most to the total percentage canopy spread in those strata. Species with high percentage apparent canopy cover values and densities are *Colophospermum mopane*, *Combretum apiculatum* and *Grewia bicolor* (Table 6).

2. The *Colophospermum mopane*-*Dalbergia melanoxylon*-*Heteropogon contortus* shrub savanna

This savanna covers the whole southern part of the central basalt plains as well as large areas of the Malvernian Formation on the eastern and western border of the Pafuri area. It can be divided into two communities (2.1, 2.2) which are characterised by species groups L and N respectively (Table 1), while species groups M, O and P reveal the affinities with the other *Colophospermum mopane* communities. The absence of species such as *Euclea divinorum*, *Boscia albitrunca*, *Sterculia rogersii*, *Spirostachys africana*, *Acalypha indica*, *Pupalia lappacea*, *Pseudobrachiaria deflexa* and *Hibiscus sidiiformis* in community 2.2 is noteworthy.

Community 2.1 is found on the Malvernian formation on dark brown soil with a high pH and high carbonate concentration while community 2.2 is found on basalt and andesite on a dark red brown to brownish black soil with a neutral pH and no carbonates.

2.1 The *Colophospermum mopane*-*Enneapogon scoparius* shrub savanna

This shrub savanna is found at 215 to 445 m above sea level on moderate slopes with a gradient from 2° to 10°. The community appears in two isolated patches, one along the Shilahlandonga and the other at Matule Hill in the Pafuri area (Figs 1, 6 & 7).

The parent material weathers to a shallow, fine textured dark brown sandy loam, sandy clay loam or clay soil. Up to 10 % of the soil surface is covered with stones. The topsoil has a poorly developed blocky structure and a friable consistency. The soil is alkaline with a pH ranging from 7.9 to 8.4 and has a normal to moderate soluble salt concentration. Carbonates are present in high concentrations.

According to the physiognomic classification of Tinley (1969) the community at Shilahlandonga should be classified as a shrub savanna whereas the variation at Matule Hill should be described as a tree savanna. Both variations are characterised by species group L (Table 1) but they differ structurally.



FIG. 6.

The Shilahlandonga variation of the *Colophospermum mopane*-*Enneapogon scoparius* shrub savanna in the foreground.

Floristic composition

The community is characterised by the presence of *Colophospermum mopane*, *Maytenus heterophylla*, *Euclea schimperi* and *Dalbergia melanoxylon*. At Shilahlandonga trees do not normally become more than 5 m high, whereas they grow up to 8 m high at Matule. Shrubs reach up to 2 m and include species such as *Grewia bicolor*, *Maytenus heterophylla* and *Acacia nigrescens* as well as *Combretum apiculatum*, *Terminalia prunioides*, *Euclea divinorum*, *Sterculia rogersii* and *Commiphora mollis*.

The herbaceous component is characterised by *Enneapogon scoparius*, *Seddera capensis*, *Aristida congesta* subsp. *congesta* with associated species including *Heteropogon contortus*, *Fingerhuthia africana*, *Indigofera vicioides*, *Rhynchosia totta*, *Eragrostis superba*, *Barleria lancifolia*, *Tephrosia polystachya* and *Phyllanthus pentandrus*. The absence of *Panicum maximum* is noteworthy.

Isolated patches of the *Androstachys johnsonii*-*Croton pseudopulchellus* dry forest often occur within this community on south and north facing slopes. In the "kloofs" within this community a number of other species are found such as



FIG. 7.

The Mature variation of the *Colophospermum mopane*-*Enneapogon scoparius* shrub savanna.

Kirkia acuminata, *Ptaeroxylon obliquum*, *Maerua angolensis*, *Commiphora tenuipetiolata*, *Albizia brevifolia*, *Adansonia digitata*, *Strychnos decussata* and *Pappea capensis*.

Structure

The structural analysis of the woody component of this community is given in Tables 8, 9, 10 and 11 as well as in Figures 10 and 11. Since the structure of the two isolated patches differ, the variations are discussed separately.

a. The Shilahlandonga variation (Tables 8 and 9 and Fig. 6)

The highest total percentage canopy spread is found in the 0,5 m stratum. Shrubs have the highest values in the 0,5 m and 1 m strata although sparse shrubs are more numerous in the 0,5 m stratum. From the 2 m stratum and above, the total percentage canopy spread is low (Table 8). *Colophospermum mopane* has high canopy spread percentages in all the strata up to the 4-5 m stratum with the exception of the 3 m stratum. *Terminalia prunioides* also has a high percentage canopy spread in the 2 m and 3 m strata (Table 9). The sparse shrubs have the highest density of the three growth forms and no plants are found in the >6 m stratum. Species with a high percentage apparent canopy cover are *Colophospermum mopane* and *Terminalia prunioides*.

TABLE 8.
Percentage canopy spread in different strata and the mean number of individuals per hectare (indiv./ha) in different height classes of woody plant species in the *Colophospermum mopane*-*Enneapogon scoparius* shrub savanna (Shilahlandonga variation).

Stratum (m)	Total*	Percentage canopy spread										Mean number of indiv./ha		
		Growth form					Height class					Height class (m)	Total	
		Tree		Sparse shrub		Shrub	>6 m		4-5 m	3 m	2 m			1 m
		0.10		0.60		0.81	0.05		0.10	1.69	1.29			0.88
>6	0.10	1.74	2.97	0.55	1.78	0.42	0.01		0.90	0.88	5.42	4.29	Total	
4-5	0.10	0.60	1.02	0.55	0.33	0.81	0.05		1.69	1.29	0.88	5.42	Total	
3	1.74	0.60	1.02	0.55	0.33	0.81	0.05		1.69	1.29	0.88	5.42	Total	
2	2.97	1.02	1.00	1.78	0.321	0.42	0.01		0.90	0.88	5.42	4.29	Total	
1	7.20	1.00	1.78	0.55	0.321	0.42	0.01		0.90	0.88	5.42	4.29	Total	
0.5	9.01	0.20	1.00	0.55	0.321	0.42	0.01		0.90	0.88	5.42	4.29	Total	
*Figures in this column are referred to in the text as "Total percentage canopy spread" values														

16	20	434	433	36	9	1 100	1 578	1 036
2	41	94	66	203				
2	2	66	150	933	1 666	2 817		
>6								
4-5								
3								
2								
1								
0.5								
Height class (m)	Total	Tree	Sparse shrub	Shrub				
Growth form								
Percentage canopy spread	Mean number of indiv./ha							

TABLE 9.

Percentage canopy spread in different strata; mean number of individuals per hectare (indiv./ha) and the percentage apparent canopy cover (p.a.c.) of a few species* in the *Colophospermum mopane*-*Enneapogon scoparius* shrub savanna (Shilahladonga variation).

Plant species*	p.a.c.	indiv./ha	Percentage canopy spread					
			Stratum (m)					
			>6	4-5	3	2	1	0,5
Colophospermum mopane	8,99	1 759		0,10	0,68	1,38	5,44	5,93
Terminalia prunioides	1,08	22			0,98	1,04	0,52	0,10
Euclea schimperi	0,85	100					0,17	0,73
Combretum apiculatum	0,55	201			0,02	0,06	0,08	0,49
Dalbergia melanoxylon	0,49	242				0,07	0,22	0,41
Sterculia rogersii	0,29	8				0,29	0,19	0,04
Cissus lonicerifolius	0,26	33					0,26	0,09
Strychnos madagascariensis	0,20	50					0,15	0,10
Acacia nigrescens	0,04	1			0,02	0,04	0,01	
Commiphora mollis	0,04	1			0,04	0,02		

*Only the ten species with the highest percentage apparent canopy cover (p.a.c.)

b. The Matule variation (Tables 10 and 11 and Fig. 7)

In contrast to the previous variation, the highest total percentage canopy spread occurs in the >6 m stratum, where trees and sparse shrubs have high percentages (Table 10). *Colophospermum mopane* has the highest percentage canopy spread in all the strata save the 1 m stratum while *Grewia bicolor* and *Dichrostachys cinerea* also have high values in the 0.5 m and 1 m strata (Table 11). Sparse shrubs collectively are most numerous while shrubs are relatively scarce from the 3 m stratum upwards. *Colophospermum mopane* and *Grewia bicolor* have high apparent canopy cover values while *Colophospermum mopane*, *Dichrostachys cinerea*, *Acacia nigrescens*, *Combretum apiculatum* and *Grewia bicolor* have high densities (Table 11).

2.2 The *Colophospermum mopane*–*Themeda triandra* shrub savanna

This community is found on the plains southeast of Klopperfontein at 385 to 452 m above sea level (Figs 1 & 8).

The basalt and andesite of the Karroo System which occurs in this area weathers to a fine to medium textured dark red brown to brown black sandy clay loam or clay soil varying from 90 to 850 mm in depth. The topsoil has a moderately to well developed blocky structure and a friable to firm consistency. No stones are generally found on the soil surface. The pH ranges from 6.1 to 7.4 and the soils have a moderate to normal soluble salt concentration, although it may be leached in certain areas. Carbonates are usually absent.

Floristic composition

Trees are scarce and usually only from 3 to 5 m high, with only a few individuals becoming more than 6 m high. The most striking species are *Colophospermum mopane*, *Combretum imberbe* and *C. apiculatum*. The shrub layer is very well developed and includes species such as *Dalbergia melanoxylon*, *Cissus lonicerifolius*, *Colophospermum mopane* and *Lonchocarpus capassa*. Patches where *Pterocarpus rotundifolius*, *Dalbergia melanoxylon*, *Dichrostachys cinerea* and *Albizia harveyi* are dominant occur localised. The associated species within this community are *Combretum hereroense*, *Cassia petersiana*, *C. abbreviata*, *Grewia bicolor*, *G. monticola*, *Lannea stuhlmannii*, *Acacia nigrescens* and *Maytenus heterophylla*.

The herbaceous component is well developed and characterised by the presence of *Themeda triandra*, *Neorautanenien amboensis*, *Setaria woodii* and *Panicum coloratum*. A few other species which also have high cover values include *Heteropogon contortus*, *Bothriochloa insculpta*, *Digitaria eriantha* and *Panicum maximum*. The associated herbaceous species are *Eragrostis superba*, *Sorghum versicolor*, *Schmidtia pappophoroides*, *Vernonia fastigiata*, *Aristida congesta* subsp. *barbicollis*, *Indigofera heterotricha*, *Heliotropium strigosum*, *Eragrostis rigidior* and *Cenchrus ciliaris*.

TABLE 10.

Percentage canopy spread in different strata and the mean number of individuals per hectare (indiv./ha) in different height classes of woody plant species in the *Colophospermum mopane*-*Enneapogon scoparius* shrub savanna (Matule variation).

Stratum (m)	Percentage canopy spread										Mean number of indiv./ha				
	Total*	Growth form			Height class						Height class (m)	Total	Growth form		
		Tree	Sparse shrub	Shrub	>6 m	4–5 m	3 m	2 m	1 m	0,5 m			Tree	Sparse shrub	Shrub
>6	16,45	11,41	5,04		16,45						>6	222	186	36	
4–5	14,07	10,67	3,24	0,16	12,33	1,74					4–5	62	29	26	7
3	9,78	6,15	2,86	0,77	5,88	2,55	1,35				3	88	47	34	7
2	9,55	2,65	2,73	4,17	2,15	1,75	1,39	4,26			2	300	25	125	150
1	8,21	0,95	2,18	5,08	0,78	0,41	0,42	5,24	1,36		1	325	25	150	150
0,5	7,58	0,27	3,10	4,21		0,06	0,24	3,14	2,38	1,76	0–5	450	50	300	100
											Total	1 447	362	671	414

*Figures in this column are referred to in the text as "Total percentage canopy spread" values



FIG. 8.

The *Colophospermum mopane*-*Themeda triandra* shrub savanna on the basalt south of Kloverfontein.

Dambo's and rain pans occur along streams and on the plains within this community. These areas are characterised by the following species:

<i>Hyphaena natalensis</i>	<i>Sporobolus consimilis</i>
<i>Phoenix reclinata</i>	<i>Sesbania sesban</i>
<i>Combretum imberbe</i>	<i>Setaria sphacelata</i>
<i>Lonchocarpus capassa</i>	<i>Ischaemum afrum</i>

Structure

The structural analysis of the woody component of this community is given in Tables 12 and 13 as well as in Figures 10 and 11.

The highest total percentage canopy spread occurs in the 1 m stratum. While the 0.5 and 2 m strata are still fairly well developed, the 3 m stratum and above are poorly developed (Table 12). In the 1 m and 2 m strata *Colophospermum mopane*, *Combretum apiculatum* and *Dalbergia melanoxylon* (Table 13) have relatively high canopy cover percentages. Species of the 3 m, 4-5 m and >6 m height classes, among which *Colophospermum mopane* and *Combretum apiculatum* are important, have low canopy spread percentages.

The 0.5 m and 1 m height classes have the highest density. In the 0.5 m height class, sparse shrubs are most numerous whereas shrubs are most numerous in the 1 m height class (Table 12).

TABLE 12.
Percentage canopy spread in different strata and the mean number of individuals per hectare (indiv./ha) in different height classes of woody plant species in the *Colophospermum mopane*-*Themeda triandra* shrub savanna.

Stratum (m)	Percentage canopy spread										Mean number of indiv./ha				
	Total*	Growth form			Height class						Height class (m)	Total	Growth form		
		Tree	Sparse shrub	Shrub	>6m	4-5m	3m	2m	1m	0,5m			Tree	Sparse shrub	Shrub
>6	0,23	0,19	0,04		0,23						>6	2	2		
4-5	0,69	0,24	0,31	0,14	0,15	0,54					4-5	16	4	9	3
3	1,59	0,40	0,67	0,50	0,05	0,75	0,79				3	55	13	24	18
2	4,18	0,54	1,31	2,33	0,05	0,46	1,40	2,27			2	198	20	66	112
1	8,55	0,33	2,13	6,09	0,02	0,11	0,93	2,75	4,74		1	541	45	208	288
0,5	7,87	0,18	1,84	5,85		0,02	0,48	2,02	4,29	1,06	0-5	480	71	317	92
											Total	1 292	155	624	513

*Figures in this column are referred to in the text as "Total percentage canopy spread" values

TABLE 13.

*Only the ten species with the highest percentage apparent canopy cover (p.a.c.)

*Only the ten species with the highest percentage apparent canopy cover (p.a.c.)

Colophospermum mopane has the highest percentage apparent canopy cover, followed by *Combretum apiculatum* and *Dalbergia melanoxylon*, while *Colophospermum mopane*, *Dalbergia melanoxylon* and *Commiphora africana* have high densities (Table 13).

3. The *Colophospermum mopane*-*Combretum apiculatum*-*Digitaria eriantha* open tree savanna

This community is found in the broken country in the Pafuri area, along the Madzaringwe and in the vicinity of the Machayi and Wambiya pans. It occurs on plains and on gentle to moderately steep ($1-15^\circ$) north, east, southwest and south facing slopes between 230 and 475 m above sea level (Figs 1 & 9).

This community occurs on basalt, diabase, aeolian sand and gravel of the Quaternary. The loamy sand to clay soil is dark red brown to brown black and fine to medium textured. Up to 15 % of the soil surface can be covered with stones. The soils are shallow to deep and the topsoil is apedal with a poorly developed blocky structure and a loose to friable consistency. The pH varies from 6.1 to 7.2. Although the soil usually contains a moderate soluble salt concentration it is strongly leached in parts. In most cases carbonates are present in the topsoil.

Floristic composition

Most of the tree species are from 4 to 5 m high, while some trees are up to 8 m high. The conspicuous trees are *Colophospermum mopane*, *Sclerocarya caffra* and *Combretum apiculatum*. The shrub layer which becomes up to 2 m high, includes *Colophospermum mopane*, *Combretum apiculatum*, *Grewia bicolor* and *Dichrostachys cinerea*. A few other common woody species are *Acacia nigrescens*, *Boscia albitrunca*, *Combretum mossambicense*, *Euclea divinorum*, *Markhamia acuminata*, *Securinega virosa*, *Commiphora mollis* and *Sterculia rogersii*.

The herbaceous component is characterised by *Digitaria eriantha* and *Schmidtia pappophoroides* as well as *Panicum maximum*, *Aristida congesta* subsp. *congesta*, *Vigna unguiculata*, *Tephrosia polystachya*, *Phyllanthus pentandrus*, *Hibiscus micranthus* and *Solanum panduraeforme*. A few other associated species are *Heteropogon contortus*, *Aristida congesta* subsp. *barbicollis*, *Neuracanthus africanus*, *Fingerhuthia africana*, *Indigofera vicioides*, *Kyphocarpa angustifolia*, *Crotalaria virgulata* and *Euphorbia tettensis*.

Structure

The structural analysis of the woody component of this community is given in Tables 14 and 15 as well as in Figures 10 and 11.

The highest total percentage canopy spread is found in the 3 m stratum (Table 14). *Combretum apiculatum* has a high canopy spread percentage in this



FIG. 9.

The *Colophospermum mopane*-*Combretum apiculatum*-*Digitaria eriantha* open tree savanna.

stratum, whereas *Colophospermum mopane* has high percentages in the 3 m, 4–5 m and >6 m strata (Table 15). Up to the 2 m stratum sparse shrubs are most numerous and have the highest total percentage canopy spread; from the 3 m stratum trees predominate. Shrubs are relatively scarce and in the 4–5 m and >6 m height classes trees are most numerous (Table 14).

Colophospermum mopane, *Combretum apiculatum* and *Dalbergia melanoxylon* have high densities and *Colophospermum mopane* (13,47 %) and *Combretum apiculatum* (11,55 %) also have the highest percentage apparent canopy cover (Table 15),

COMPARISON OF STRUCTURE

In Figure 10 the first three communities (1.1; 1.2 and 1.3) have the same basic pattern for the total percentage canopy spread: there is an increase from the 0,5 m stratum up to the 2 m stratum whereafter the values decrease progressively with increasing stratum height.

In community 3 the highest total percentage canopy spread occurs in the 3 m stratum. The Shilahlandonga variation (a) of community 2.1 has more or less the same percentage canopy spread as community 2.2. However, in community 2.1

TABLE 14.

Percentage canopy spread in different strata and the mean number of individuals per hectare (indiv./ha) in different height classes of woody plant species in the *Colophospermum mopane*-*Combretum apiculatum*-*Digitaria eriantha* open tree savanna.

Stratum (m)	Percentage canopy spread										Mean number of indiv./ha				
	Total*	Growth form			Height class						Height class (m)	Total	Growth form		
		Tree	Sparse shrub	Shrub	>6m	4-5m	3m	2m	1m	0,5m			Tree	Sparse shrub	Shrub
>6	5,51	5,30	0,21		5,51						>6	44	41	3	
4-5	10,60	7,25	1,81	1,54	5,46	5,14					4-5	173	81	46	46
3	14,79	5,95	4,58	4,26	3,71	5,51	5,57				3	310	74	177	59
2	13,65	2,48	6,24	4,93	0,79	3,56	5,73	3,57			2	396	135	186	75
1	8,86	1,14	4,18	3,54	0,08	0,91	2,47	3,32	2,08		1	458	103	263	92
0,5	5,45	0,52	2,75	2,18	0,01	0,26	0,82	1,63	1,36	1,37	0-5	682	145	471	66
											Total	2 063	579	1 146	338

*Figures in this column are referred to in the text as "Total percentage canopy spread" values

TABLE 15.
Percentage canopy spread in different strata, mean number of individuals per hectare (indiv./ha) and the percentage apparent canopy cover (p.a.c.) of a few species* in the *Colophospermum mopane*-*Combretum apiculatum*-*Digitaria eriantha* open tree savanna.

Plant species*	p.a.c.	indiv./ha	Stratum (m)					Percentage canopy spread				
			>6	4-5	3	2	1	0.5				
<i>Colophospermum mopane</i>	13,47	928	4,45	6,30	5,33	4,02	3,74	2,44				
<i>Combretum apiculatum</i>	11,55	453	0,10	3,03	8,19	8,22	3,22	1,08				
<i>Grewia bicolor</i>	0,86	54										
<i>Sclerocarya caffra</i>	0,82	11	0,59	0,79	0,62	0,64	0,68	0,55				
<i>Acacia nigrescens</i>	0,71	109	0,31	0,19	0,15	0,18	0,17	0,25				
<i>Dalbergia melanoxylon</i>	0,47	163			0,16	0,28	0,26	0,26				
<i>Combretum mossambicense</i>	0,30	121				0,02	0,07	0,27				
<i>Dichrostachys cinerea</i>	0,23	52				0,11	0,13	0,09				
<i>Boscia albitrunca</i>	0,22	21				0,02	0,05	0,03				
<i>Cissus lonicifolia</i>	0,20	18				0,02	0,20	0,11				

*Only the ten species with the highest percentage apparent canopy cover (p.a.c.)

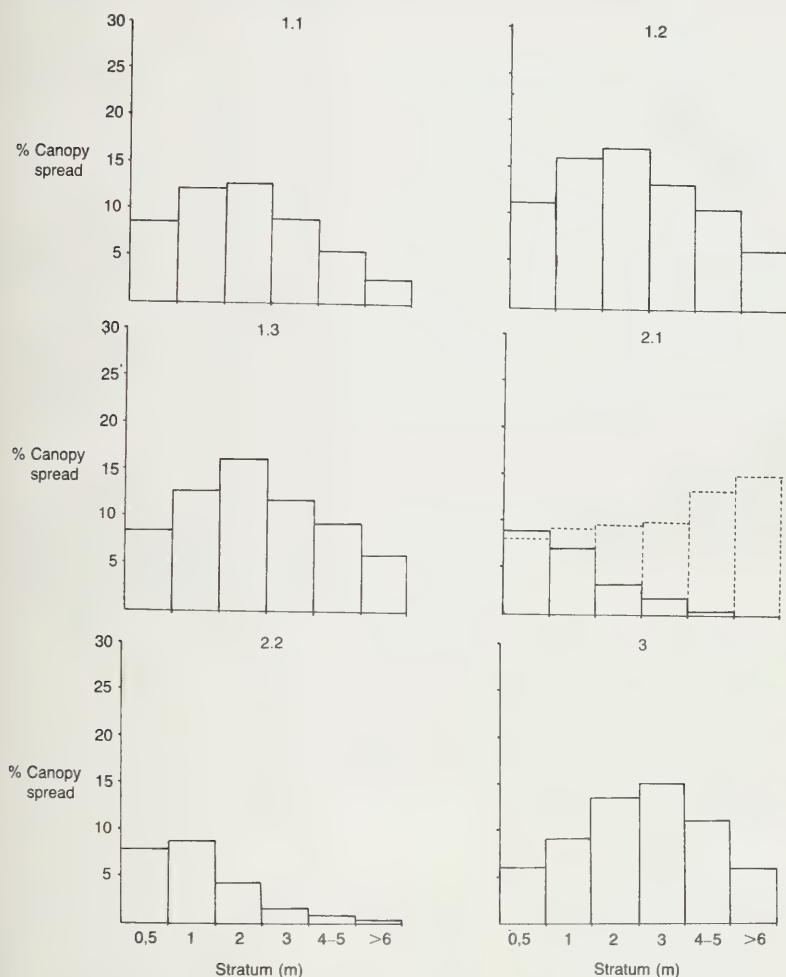


FIG. 10.

A diagrammatic presentation of the total percentage canopy spread of woody plants in different strata of the *Colophospermum mopane* communities.

- 1.1 The *C. mopane*-*Acacia tortilis*-*Urochloa mosambicensis* tree savanna
- 1.2 The *C. mopane*-*Euclea divinorum*-*Enteropogon macrostachyus* tall tree savanna
- 1.3 The *C. mopane*-*Commiphora glandulosa*-*Seddera capensis* open tree savanna
- 2.1 The *C. mopane*-*Enneapogon scoparius* shrub savanna
 - a. Shilahlandonga variation
 - b. Matule variation
- 2.2 The *C. mopane*-*Themeda triandra* shrub savanna
3. The *C. mopane*-*Combretum apiculatum*-*Digitaria eriantha* open tree savanna

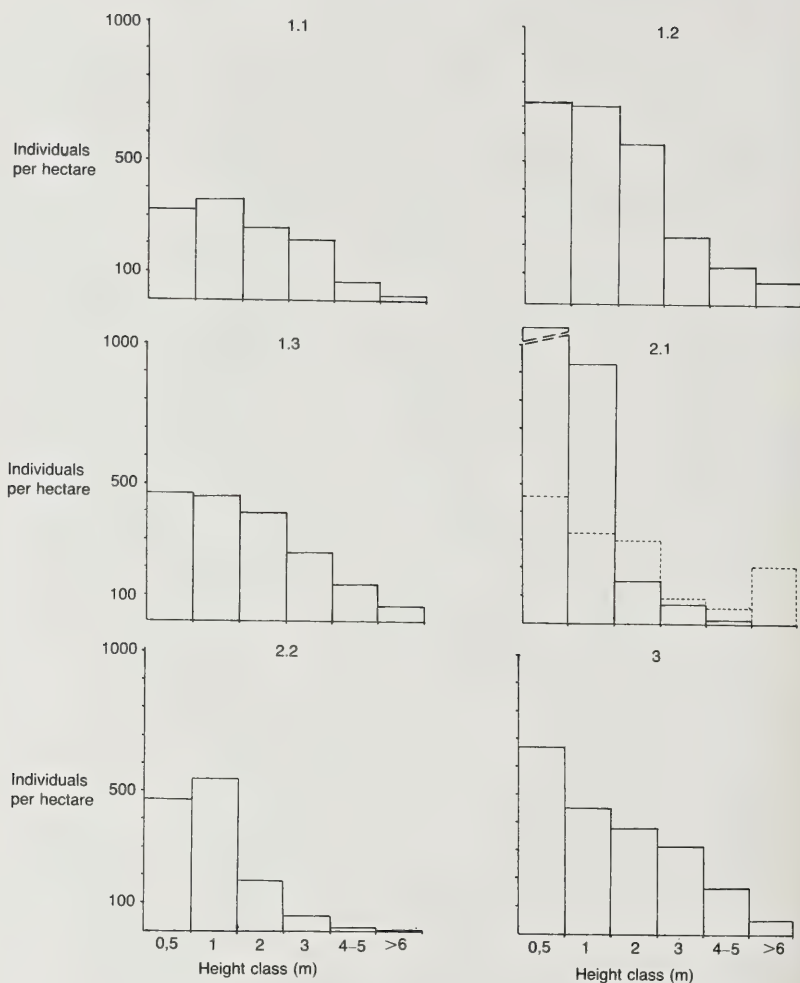


FIG. 11.

A diagrammatic presentation of the mean total individuals per hectare in different height classes of the woody plants of the *Colophospermum mopane* communities.

- 1.1 The *C. mopane*-*Acacia tortilis*-*Urochloa mosambicensis* tree savanna
- 1.2 The *C. mopane*-*Euclea divinorum*-*Enteropogon macrostachyus* tall tree savanna
- 1.3 The *C. mopane*-*Commiphora glandulosa*-*Seddera capensis* open tree savanna
- 2.1 The *C. mopane*-*Enneapogon scoparius* shrub savanna
 - a. Shilahladonga variation
 - b. Matule variation
- 2.2 The *C. mopane*-*Themeda triandra* shrub savanna
- 3. The *C. mopane*-*Combretum apiculatum*-*Digitaria eriantha* open tree savanna

(a) more individuals per hectare are found in the 0.5 m and 1 m height classes than in community 2.2. Compared to the other *Colophospermum mopane* communities these two communities have relatively low canopy spread percentages in the 4–5 and >6 strata. The Matule variation (b) of community 2.1 has a higher total percentage canopy spread in the 4–5 m and >6 m strata than the Shilahlandonga variation (a).

In general the highest number of individuals per hectare is found in the 0.5 m and 1 m height classes (Fig. 11) with a reduction in numbers in the higher height classes. There is however, a marked variation in numbers of individuals per hectare between the different communities.

The results reveal a large amount of structural variation between communities as well as within communities. Some communities differ floristically but they have the same structure, whereas others are floristically similar yet differ structurally e.g. *Colophospermum mopane*–*Enneapogon scoparius* community (Fig. 10).

CONCLUSION

In savanna plant communities, as in all living societies, there is perpetual competition for survival between individuals and evolution towards a more highly organised type of association in which the abiotic, floristic and structural components are in equilibrium with one another.

Successful management of large areas covered with natural vegetation depends largely on a knowledge of the composition of the vegetation, the extent to which it is being utilised and the changes which take place in response to differential use by herbivores and fire (Walker, 1976). Where fire and utilisation have the greatest influence on savanna vegetation (Glover, 1968) it is necessary to study the floristic composition and structure in areas that are subjected to different intensities of burning and grazing in order to observe the changes brought about by such treatments.

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